# FCC PART 15.249

# TEST REPORT

For

## Shenzhen Rapoo Technology Co., Ltd.

22, Jinxiu Road East, Pingshan District, Shenzhen, China

## FCC ID: PP2M11

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | Wireless Optical Mouse |
| **Test Engineer:** | Allen Qiao |
| **Report Number:** | RDG140928008-00 |
| **Report Date:** | 2014-12-04 |
| **Reviewed By:** | Sula Huang<br>RF Engineer |
| **Test Laboratory:** | Bay Area Compliance Laboratories Corp. (Dongguan)<br>No.69 Pulongcun, Puxinhu Industrial Zone,<br>Tangxia, Dongguan, Guangdong, China<br>Tel: +86-769-86858888<br>Fax: +86-769-86858891<br>www.baclcorp.com.cn |

# TABLE OF CONTENTS

# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

The *Shenzhen Rapoo Technology Co., Ltd.*'s product, model number: *M11 (FCC ID: PP2M11)* (the "EUT") in this report was a *Wireless Optical Mouse*, was measured approximately: 9.6 cm (L) x6.0 cm (W) x 3.3cm (T), rated input voltage: DC 1.5V*1 AA battery.

*All measurement and test data in this report was gathered from production sample serial number: 140928008. (Assigned by BACL, Dongguan). The EUT was received on 2014-09-29.*

## Objective

This type approval report is prepared on behalf of *Shenzhen Rapoo Technology Co., Ltd.* in accordance with Part 2-Subpart J, and Part 15-Subparts A, B and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 rules.

## Related Submittal(s)/Grant(s)

N/A.

## Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Dongguan).

## Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 02, 2012. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

# SYSTEM TEST CONFIGURATION

## Justification

The system was configured for testing in engineering mode, which was provided by the manufacturer. The engineering mode was configured under maximum power output and switched the channels by key.

16 channels were provided by the manufacturer:

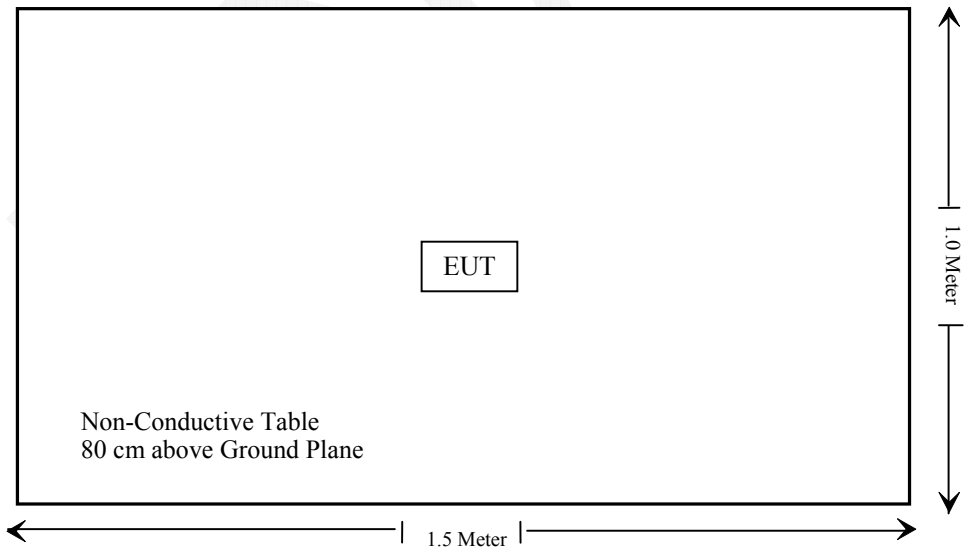
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|---|---|---|---|
| 1 | 2402 | 5 | 2425 | 9 | 2446 | 13 | 2471 |
| 2 | 2405 | 6 | 2428 | 10 | 2451 | 14 | 2474 |
| 3 | 2409 | 7 | 2431 | 11 | 2454 | 15 | 2477 |
| 4 | 2413 | 8 | 2434 | 12 | 2457 | 16 | 2479 |

EUT was tested with Channel 2402MHz, 2446MHz and 2479MHz.

## EUT Exercise Software

No software was used during the test.

## Block Diagram of Test Setup



# SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|---|---|---|
| §15.203 | Antenna Requirement | Compliance |
| §15.207(a) | Conduction Emissions | Not Applicable |
| 15.205, §15.209, §15.249 | Radiated Emissions | Compliance |
| §15.215 (c) | 20 dB Bandwidth | Compliance |
| §15.249(d) | Outside of Band Emission (50dB attenuation) | Compliance |

Not Applicable: The EUT is battery operated equipment.

# FCC§15.203 - ANTENNA REQUIREMENT

## Applicable Standard

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

## Antenna Connector Construction

The EUT has one integral antenna arrangement and antenna gain is 2.17dBi, which was permanently attached ,fulfill the requirement of this section, please refer to the EUT photos.

**Result:** Compliant.

# FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS

## Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|---|---|---|
| 902–928 MHz | 50 | 500 |
| 2400–2483.5 MHz | 50 | 500 |
| 5725–5875 MHz | 50 | 500 |
| 24.0–24.25 GHz | 250 | 2500 |

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

## Measurement Uncertainty

Compliance or non- compliance with a disturbance limit shall be determined in the following manner：

If $U_{lab}$ is less than or equal to $U_{cispr}$ of Table 1, then:
- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If $U_{lab}$ is greater than $U_{cispr}$ of Table 1, then:
- compliance is deemed to occur if no measured disturbance level, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit.

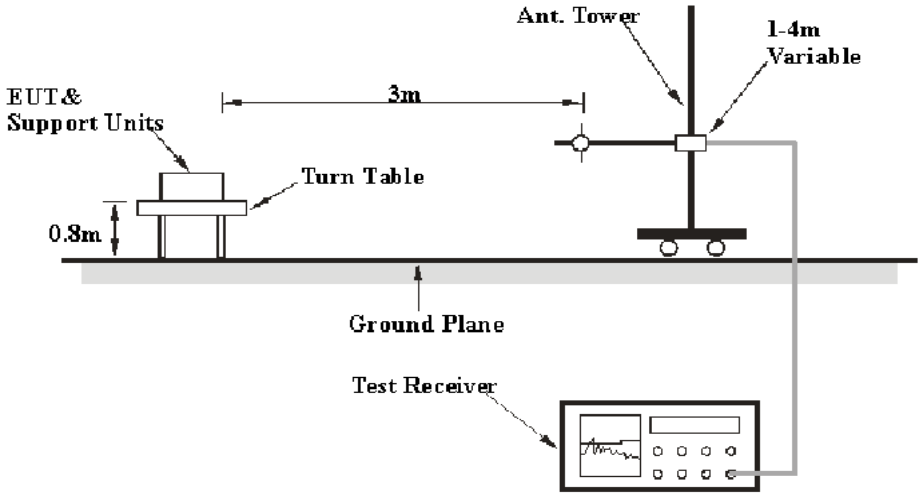
Based on CISPR 16-4-2: 2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Dongguan) is:
30M~200MHz: 5.0 dB
200M~1GHz: 6.2 dB
1G~6GHz: 4.45 dB
6G~18GHz: 5.23 dB

Table 1 – Values of $U_{cispr}$

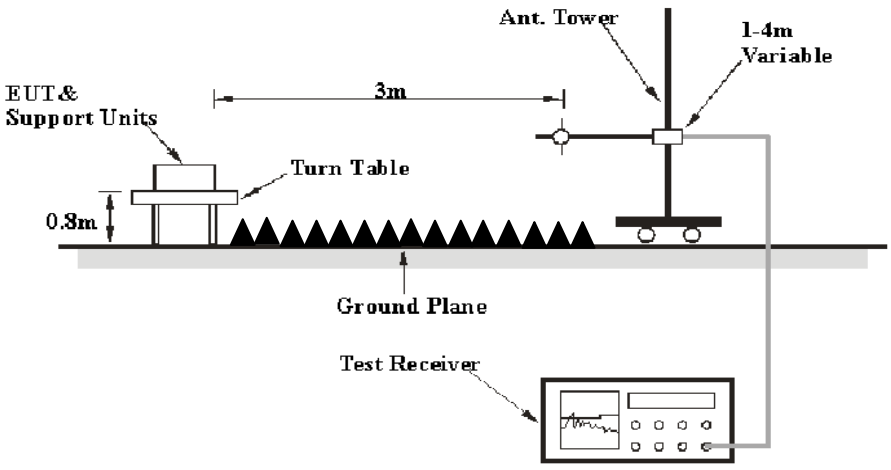
| Measurement | $U_{cispr}$ |
|---|---|
| Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz) | 6.3 dB |
| Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz) | 5.2 dB |
| Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz) | 5.5 dB |

## EUT Setup

Below 1 GHz:




Above 1 GHz:




The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

## Test Equipment Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

| Frequency Range | RBW | Video B/W | IF B/W | Detector |
|---|---|---|---|---|
| 30 MHz – 1000 MHz | 120 kHz | 300 kHz | 120 kHz | QP |
| Above 1 GHz | 1MHz | 3 MHz | / | PK |
| | 1MHz | 10 Hz | / | Ave. |

## Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detection mode from 30MHz to 1GHz, Peak and average detection mode above 1 GHz.

## Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit –Corrected Amplitude

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | EMI Test Receiver | ESCI | 100224 | 2014-05-09 | 2015-05-09 |
| Sunol Sciences | Antenna | JB3 | A060611-3 | 2014-07-28 | 2017-07-27 |
| HP | Amplifier | 8447E | 2434A02181 | 2014-09-01 | 2015-09-01 |
| R&S | Spectrum Analyzer | FSEM | DE31388 | 2014-05-09 | 2015-05-09 |
| ETS-Lindgren | Horn Antenna | 3115 | 000 527 35 | 2012-09-06 | 2015-09-06 |
| Mini-Circuit | Amplifier | ZVA-213-S+ | 054201245 | 2014-02-19 | 2015-02-19 |
| R&S | Spectrum Analyzer | FSP 38 | 100478 | 2014-05-09 | 2015-05-09 |
| Ducommun Technolagies | Horn Antenna | ARH-4223-02 | 1007726-01 1304 | 2014-06-16 | 2017-06-15 |
| Quinstar | Amplifier | QLW-18405536-JO | 15964001001 | 2014-09-06 | 2015-09-06 |

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

## Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.209 &15.205 & 15.249, with the worst margin reading of:

**7.20 dB** at **2483.5 MHz** in the **Vertical** polarization

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25.6°C |
| **Relative Humidity:** | 52% |
| **ATM Pressure:** | 101.2 kPa |

*The testing was performed by Allen Qiao on 2014-10-14.*

*Test Mode: Transmitting*

| Frequency (MHz) | Receiver | | Rx Antenna | | Cable loss (dB) | Amplifier Gain (dB) | Corrected Amplitude (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | Detector (PK/QP/AV) | Polar (H/V) | Factor (dB(1/m)) | | | | | |
| **Low Channel: 2402 MHz** | | | | | | | | | |
| 2402 | 91.24 | PK | H | 25.65 | 4.42 | 27.32 | 93.99 | 114.00 | 20.01 |
| 2402 | 76.38 | AV | H | 25.65 | 4.42 | 27.32 | 79.13 | 94.00 | 14.87 |
| 2402 | 86.67 | PK | V | 25.65 | 4.42 | 27.32 | 89.42 | 114.00 | 24.58 |
| 2402 | 71.27 | AV | V | 25.65 | 4.42 | 27.32 | 74.02 | 94.00 | 19.98 |
| 2390 | 55.80 | PK | H | 25.61 | 4.39 | 27.32 | 58.48 | 74.00 | 15.52 |
| 2390 | 23.29 | AV | H | 25.61 | 4.39 | 27.32 | 25.97 | 54.00 | 28.03 |
| 4804 | 46.76 | PK | V | 30.59 | 5.98 | 27.41 | 55.92 | 74.00 | 18.08 |
| 4804 | 27.76 | AV | V | 30.59 | 5.98 | 27.41 | 36.92 | 54.00 | 17.08 |
| 7206 | 34.01 | PK | V | 34.09 | 7.45 | 25.91 | 49.64 | 74.00 | 24.36 |
| 7206 | 19.66 | AV | V | 34.09 | 7.45 | 25.91 | 35.29 | 54.00 | 18.71 |
| 9608 | 30.97 | PK | V | 35.96 | 8.80 | 27.55 | 48.18 | 74.00 | 25.82 |
| 9608 | 17.90 | AV | V | 35.96 | 8.80 | 27.55 | 35.11 | 54.00 | 18.89 |
| 1792.6 | 33.70 | PK | H | 24.19 | 3.52 | 27.54 | 33.87 | 74.00 | 40.13 |
| 1792.6 | 22.24 | AV | H | 24.19 | 3.52 | 27.54 | 22.41 | 54.00 | 31.59 |
| 179.38 | 37.17 | QP | H | 11.37 | 1.60 | 21.45 | 28.69 | 43.50 | 14.81 |
| **Middle Channel: 2446 MHz** | | | | | | | | | |
| 2446 | 89.30 | PK | H | 25.76 | 4.40 | 27.34 | 92.12 | 114.00 | 21.88 |
| 2446 | 74.64 | AV | H | 25.76 | 4.40 | 27.34 | 77.46 | 94.00 | 16.54 |
| 2446 | 86.23 | PK | V | 25.76 | 4.40 | 27.34 | 89.05 | 114.00 | 24.95 |
| 2446 | 71.24 | AV | V | 25.76 | 4.40 | 27.34 | 74.06 | 94.00 | 19.94 |
| 4892 | 50.34 | PK | V | 30.82 | 6.08 | 27.42 | 59.82 | 74.00 | 14.18 |
| 4892 | 32.09 | AV | V | 30.82 | 6.08 | 27.42 | 41.57 | 54.00 | 12.43 |
| 7338 | 32.64 | PK | V | 34.41 | 7.52 | 25.88 | 48.69 | 74.00 | 25.31 |
| 7338 | 19.11 | AV | V | 34.41 | 7.52 | 25.88 | 35.16 | 54.00 | 18.84 |
| 9784 | 30.51 | PK | V | 36.38 | 8.84 | 27.16 | 48.57 | 74.00 | 25.43 |
| 9784 | 17.75 | AV | V | 36.38 | 8.84 | 27.16 | 35.81 | 54.00 | 18.19 |
| 1792.6 | 34.79 | PK | H | 24.19 | 3.52 | 27.54 | 34.96 | 74.00 | 39.04 |
| 1792.6 | 22.27 | AV | H | 24.19 | 3.52 | 27.54 | 22.44 | 54.00 | 31.56 |
| 2316.2 | 33.13 | PK | H | 25.42 | 4.24 | 27.31 | 35.48 | 74.00 | 38.52 |
| 2316.2 | 20.96 | AV | H | 25.42 | 4.24 | 27.31 | 23.31 | 54.00 | 30.69 |
| 179.38 | 37.31 | QP | H | 11.37 | 1.60 | 21.45 | 28.83 | 43.50 | 14.67 |
| **High Channel: 2479 MHz** | | | | | | | | | |
| 2479 | 89.63 | PK | H | 25.85 | 4.48 | 27.36 | 92.60 | 114.00 | 21.40 |
| 2479 | 74.55 | AV | H | 25.85 | 4.48 | 27.36 | 77.52 | 94.00 | 16.48 |
| 2479 | 86.47 | PK | V | 25.85 | 4.48 | 27.36 | 89.44 | 114.00 | 24.56 |
| 2479 | 71.10 | AV | V | 25.85 | 4.48 | 27.36 | 74.07 | 94.00 | 19.93 |
| 2483.5 | 63.81 | PK | V | 25.86 | 4.49 | 27.36 | 66.80 | 74.00 | 7.20 |
| 2483.5 | 27.59 | AV | V | 25.86 | 4.49 | 27.36 | 30.58 | 54.00 | 23.42 |
| 4958 | 46.47 | PK | V | 30.99 | 5.89 | 27.43 | 55.92 | 74.00 | 18.08 |
| 4958 | 26.76 | AV | V | 30.99 | 5.89 | 27.43 | 36.21 | 54.00 | 17.79 |
| 7437 | 31.28 | PK | V | 34.65 | 7.58 | 25.96 | 47.55 | 74.00 | 26.45 |
| 7437 | 19.10 | AV | V | 34.65 | 7.58 | 25.96 | 35.37 | 54.00 | 18.63 |
| 9916 | 30.66 | PK | V | 36.70 | 8.87 | 26.68 | 49.55 | 74.00 | 24.45 |
| 9916 | 18.06 | AV | V | 36.70 | 8.87 | 26.68 | 36.95 | 54.00 | 17.05 |
| 1792.6 | 33.62 | PK | H | 24.19 | 3.52 | 27.54 | 33.79 | 74.00 | 40.21 |
| 1792.6 | 22.56 | AV | H | 24.19 | 3.52 | 27.54 | 22.73 | 54.00 | 31.27 |
| 179.38 | 37.65 | QP | H | 11.37 | 1.60 | 21.45 | 29.17 | 43.50 | 14.33 |

# FCC §15.215(c) – 20 dB BANDWIDTH TESTING

## Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

## Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the test table without connection to measurement instrument. Turn on the EUT. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSP 38 | 100478 | 2014-05-09 | 2015-05-09 |

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25.6°C |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.2kPa |

** The testing was performed by Allen Qiao on 2014-10-13.*

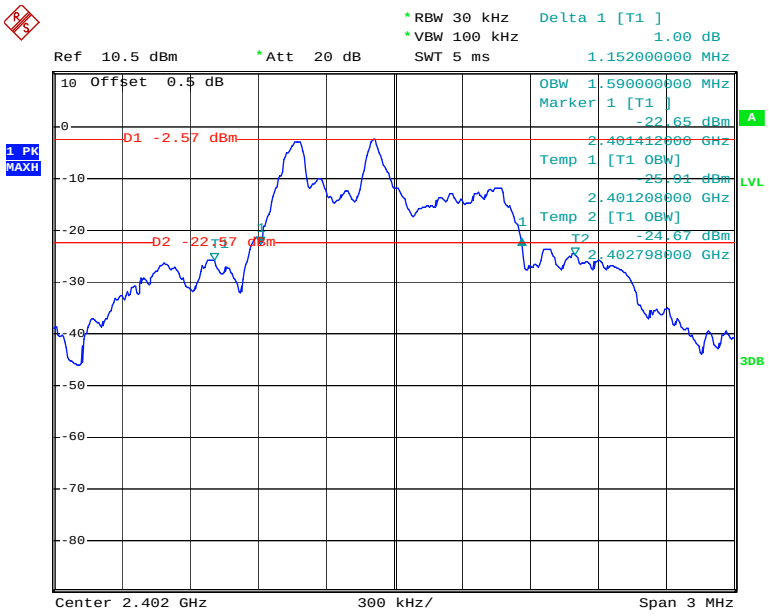
**Test Result:** Compliant.

Please refer to following tables and plots

*Test Mode: Transmitting*

| Channel | Frequency (MHz) | 20 dB Bandwidth (MHz) |
|---|---|---|
| Low | 2402 | 1.152 |
| Middle | 2446 | 1.266 |
| High | 2479 | 1.254 |

**Low Channel**

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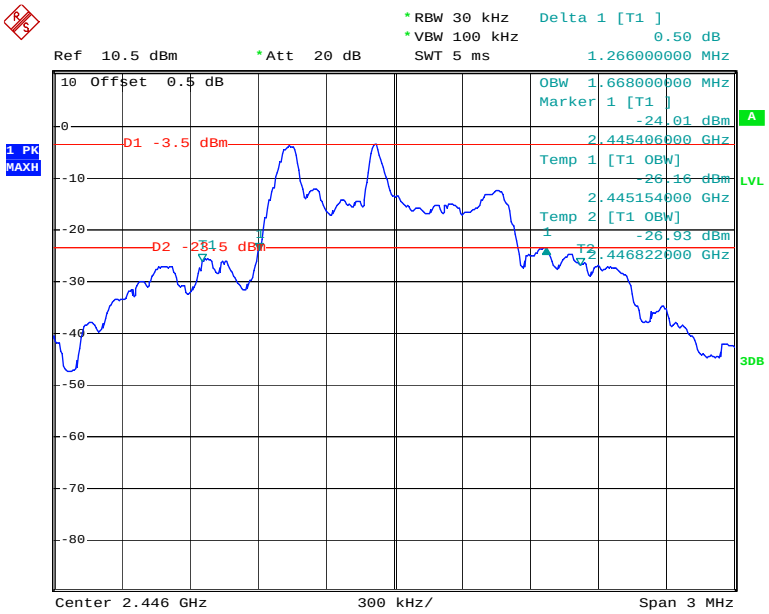
## Middle Channel

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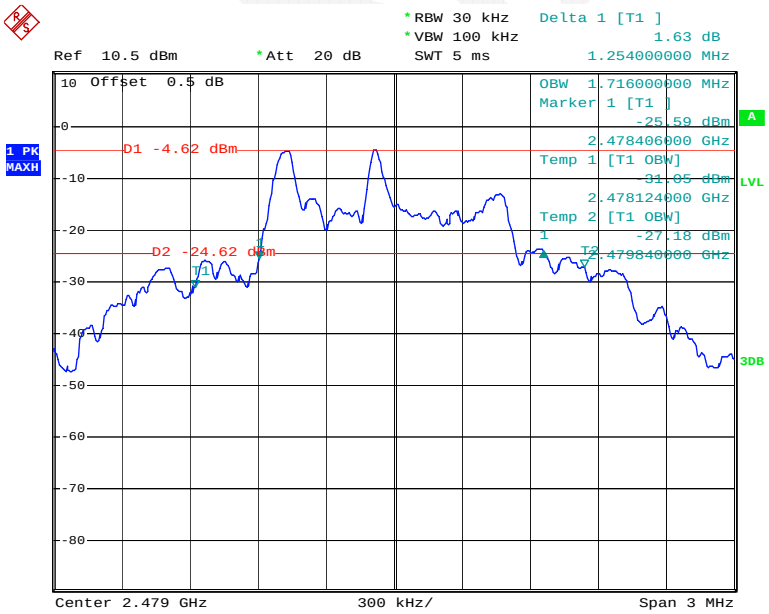
## High Channel

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# FCC§15.249(d) - OUT OF BAND EMISSION (50 dB ATTENUATION)

## Applicable Standard

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation

## Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

## Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| R&S | Spectrum Analyzer | FSP 38 | 100478 | 2014-05-09 | 2015-05-09 |

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25.6 °C |
| **Relative Humidity:** | 51 % |
| **ATM Pressure:** | 101.2kPa |

** The testing was performed by Allen Qiao on 2014-10-13.*

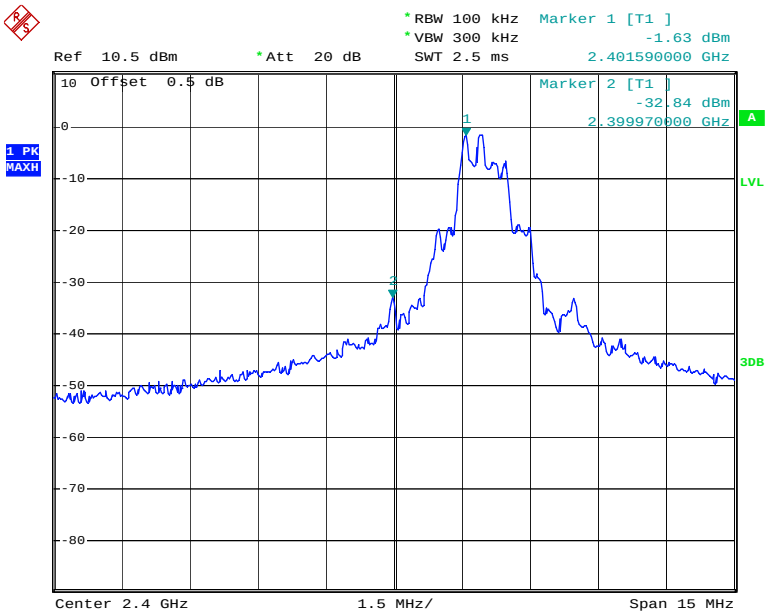
Test Result: Compliant.

Please refer to the following table and plots:

| Band Edge | Delta Peak to Band Emission (dBc) | Delta Limit (dBc) |
|---|---|---|
| Left | 31.21(note) | 50 |
| Right | 44.94(note) | 50 |

*Note：The delta peak to band emissions are compliant with 15.209 requirement.*

**Band Edge, Left Side**

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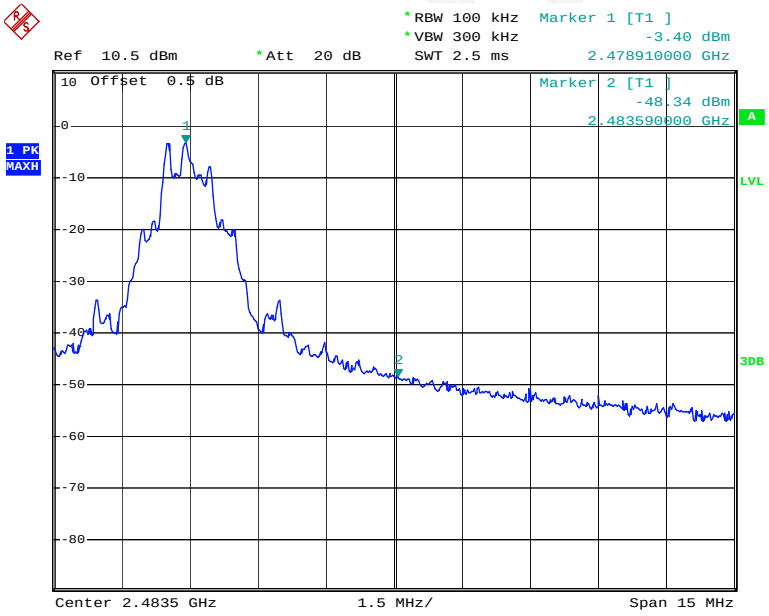
**Band Edge, Right Side**

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